Determinants and Preventive Strategies to Reduce Food Waste in Households

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ABSTRACT: Reduction and better management of food waste affects food security at the household level. Various efforts to increase availability by optimizing production have been carried out but it will be more difficult if it is not accompanied by a reduction in food waste which tends to increase, especially at the consumer level. This study aims to examine how behavior and preventive strategies to reduce food waste in households from various literatures can be used as educational materials or the basis for food waste management programs from households. This Systematic Review study was conducted using the PubMed/Medline, Science Direct, and Google Scholar search databases. Search was limited to articles in peer-reviewed journals, written in English and Indonesian between 2013 and 2022. Publications older than 2013 were not included in compiling the study. After the literature was obtained, then the articles were filtered by title and abstract, including filtering out irrelevant and duplication articles so that there were 13 articles eligible for review. Food loss and waste accounts for > 20% of all food produced, which should still be avoided because reducing food waste can increase food availability for the community. The most widely discussed determinants in the study review are behaviors that include food selection, eating habits and food processing, shopping practices, and waste minimization practices. The potential for reducing food waste can be increased with the most dominant preventive strategies, namely education and socialization, then food management at the individual level, community and government participation.

KEYWORDS: Determinants of Food Waste, Food Waste in Households, Preventive Strategies for Food Waste

INTRODUCTION

The right to adequate food is a key guiding principle in supporting food security and nutrition. This deserves to be recognized as a fundamental human right and must be upheld by every country as a duty bearer in the 1948 Universal Declaration of Human Rights, which also underlines the invisibility and interdependence of all human rights. States have duties, obligations, and responsibilities to respect, protect and fulfill human rights, including the right to food, under international law, as affirmed in Article 11 of the 1966 International Covenant on Economic, Social and Cultural Rights. The government reaffirms that the right of everyone to have access to nutritious food is consistent with the right to adequate food and the right of everyone to be free from hunger.

In the High Level Panel of Experts on Food and Security/HPLE (2020) it is explained that hunger is largely a product of the availability of sufficient food supplies at the global level and international price volatility. Although the government has supported the principle of the right to food and has put it into practice in the legal framework at the international level, the implementation of this right in practice is uneven. The issue of hunger has existed since the implementation of the traditional food system, where the main food is local food and very little processed food is available so that it is vulnerable to infectious diseases, high rates of underweight and stunting, high maternal and child mortality rates, and other factors that make people hopeful. life gets shorter.

With globalization, food systems are becoming more interconnected, with longer and more complex food supply chains. This food system offers many consumers the possibility to access new and more diverse foods throughout the year, protecting them from seasonal shortages, expanding their food choices and thereby modifying their food preferences. However, some marginalized and vulnerable groups still have limited food choices, due to gender, ethnicity or socioeconomic status. Some communities, living in remote rural areas, in urban slums or in remote areas (e.g. in mountains, forests, landlocked countries or small islands) may have limited access to diversified and quality food due to disparate food supply chains. malfunctions that are unable to provide perishable nutrient-rich foods such as fruits and vegetables. Modernization in the food system increases the demand for food, including processed and fast food. This condition affects eating habits tend to be more and is not balanced with physical activity so that it has important

implications for obesity and NCD. Changes in diet have been driven by economic development, food availability and the cost of that food (HPLE 2017).

Currently the world is facing the Covid-19 pandemic which has an impact on food supply due to increased demand caused by panic buying. Another impact of the pandemic condition is disruption to the movement of agricultural labor needed for food supply, then export restrictions that can disrupt global food supply chains and cause food prices to rise. This condition actually exacerbates the conditions of poverty and food insecurity, especially in the less fortunate groups. WHO (2021) in Health and Equity reports that the Covid-19 pandemic has increased inequality in social determinants of health in certain groups such as the poor, disadvantaged ethnic groups (indigenous people), low-paid essential workers, parents living in nursing homes, migrants. and emergency-affected populations, prisoners, and the homeless. It was further explained that poverty and deprivation are related to reduced household resources, population density, reduced access to health services, and other support in times of crisis or illness.

Based on the World Food Program (2021), at least 19.4 million people cannot fulfill their basic intake properly, which illustrates that Indonesia is still faced with the issue of a food crisis. However, at the same time the Food Waste Index Report 2021 reports that there are 20 million tons of household waste generated in Indonesia (UNEP 2021). This case illustrates the inequality in food accessibility in Indonesia. Whereas the availability and adequacy of food not only plays an important role in fulfilling sufficient caloric energy for increasing individual productivity, but also provides support for improving the quality of life and sustainable development.

Various efforts to increase availability by optimizing production have been carried out but it will be more difficult if it is not accompanied by a reduction in food waste which tends to increase, especially at the consumer level. Kariyasa and Suryana (2012) stated that food wastage occurs because food is not used properly, such as buying in large quantities and becoming expired because it is stored for too long so it is not suitable to be eaten anymore. Another example is taking too much food so there is still a lot left on the plate. The main factors for the occurrence of food waste in Indonesia are culture, poor storage so that food is damaged and then wasted, consumer preferences in choosing food, lack of public education, both producers and consumers. In addition, the behavior of consumers who take excessive portions, leaving food that is then wasted. The results of the study stated that food waste in Indonesia reached 184 kg per person per year or a total of 48 million tons in 1 year. The amount of food thrown away is equivalent to providing food for 125 million people to alleviate poverty and tackle stunting in Indonesia (Hidayat, Ardhany, and Nurhadi 2020). If food waste can be reduced by 25 percent, the potential for additional world rice food availability is estimated at 17.42 million tons per year. Meanwhile, if food waste can be reduced by 50 percent, it is estimated that there will be additional food availability from rice for the world's population of 34.84 million tons per year or equivalent to 4.98 kg per capita (Kariyasa and Suryana 2012).

Fami et al. (2021) stated that the reduction and better management of food waste affects food security at the household level. Food security is not only about increasing production but there is also a need for better distribution of food and more efficient consumption. Reducing food waste is one of the most effective ways to improve food and nutrition security by increasing food access for the poor and people who are malnourished. Based on HPLE (2020), initiatives to address food loss and waste also contribute to reducing food insecurity and promoting more efficient use of resources. From an environmental perspective, reducing food loss and waste contributes to a reduced carbon, water and soil footprint. While the focus on reducing food loss at the primary production stage in developing countries with high food insecurity, is considered to have a high positive impact on food security (FAO 2019).

Food waste management can also support a sustainable food system, where according to FAO (2019), a sustainable food system is a condition for meeting food and nutrition security for all so that the economic, social and environmental bases for future generations are not disturbed. A sustainable food system realizes quality that supports the dimensions of food security, namely productive and prosperous (ensuring sufficient food availability), fair and inclusive (ensuring access for all people and livelihoods within the system), respecting and empowering (ensuring the availability of institutions for communities to make choice and use a voice in shaping the system), resilient (ensures stability in the face of shocks and crises), regenerative (ensures sustainability in every dimension), and healthy and nutritious (ensures absorption and utilization of nutrients). In practice, just as the six dimensions of food security are interrelated, so the quality of a sustainable food system is deeply interrelated. When food systems realize these qualities in an integrated and holistic way, they are more likely to support the realization of the right to food and to meet targets by 2030, in particular the Sustainable Development Goals/SDG goal 2.

Challenges in the mindset of building sustainable food security occur among policy makers. Until now, building food security through increasing food supply is still more focused on upstream activities, such as increasing production either through increasing

productivity and expanding planting/harvesting areas, suppressing yield loss (during harvest, post-harvest, and processing). However, it has not touched much on the downstream side, namely food waste that occurs at the retail level and at the consumption stage. Therefore, the focus of policy on building food security is almost entirely focused on improving performance in the upstream sector. The impact of this mindset is that food consumption is wasted and tends to increase, then "was left" alone. On the other hand, building food security by relying solely on increased production seems to be increasingly difficult to do because of the constraints of land conversion, climate change, and price volatility.

Various ways can be done in reducing food waste, for example at the retail stage it can be reduced by providing adequate storage facilities. At the stage of consumption, which is mostly due to behavior or culture, an approach through socialization and intensive education can be made to build public awareness of food waste with a loss of economic value. Socialization can also be done by utilizing religious teachings and local wisdom that remind the public that changing behavior in food consumption towards a better direction has a real contribution to build strong and sustainable food security. In addition, good governance and the development of strong research are important elements that can support policy change because the potential to increase food availability through suppression of food wastage is so great and much more effective, both in terms of cost and level of certainty that the attention and related policies with the development of food security is expected to proportionally touch all related aspects. This study aims to examine how behaviors and preventive strategies to reduce food waste in households from various literatures can be used as educational materials or the basis for food waste management programs from households.

METHOD

This Systematic Review study was conducted using the PubMed/Medline, Science Direct, and Google Scholar search databases. Most of the journals used in the review come from the Science Direct database, where relevant articles describe the behavior and management of food waste in households and are identified using the search terms "food waste determinant", "household food waste behavior", "strategy preventive food". waste", and "reduce household food waste" by using the boolean operators "AND" and "OR" to provide a narrower and more productive search. Search was limited to articles in peer-reviewed journals, written in English and Indonesian between 2013 and 2022. Publications older than 2013 were not included in compiling the study.

After the literature was obtained, then the articles were filtered by title and abstract, including filtering out irrelevant and duplicate articles. The inclusion criteria used in this study are: (1) original/major peer-reviewed journal articles, (2) the scope of food waste being measured is at the household level, (3) indicators for measuring food insecurity are clearly defined; (4) studies conducted in various countries; (5) written in English or Indonesian; (6) foreign articles are included in Scopus and domestic articles are included in Sinta. There were 341 articles generated from the search, but with all criteria applied there were 13 articles eligible for review. The list of reviewed studies is presented in Table 1.

Table I. List of Study Reviews

Literature	Location	Title	Sample	Method	Result
Abeliotis, Lasaridi, and Chroni (2014)	Yunani	Attitudes and behaviour of Greek households regarding food waste prevention	231 Consumers	Cross Sectional (Questionnaire)	Consumers have a positive attitude towards preventing food waste. Planning food shopping carefully purchasing fresh food supplies can reduce food waste. However, about 40% misunderstood the meaning of food date labels.
Rowe, Jessop, and Sparks (2015)	United Kingdom	Identifying motivations and barriers to minimising household food waste	15 Students from 13 Households	Qualitative (Questionnaire)	Barriers to the minimization of household food waste, such as the belief that household food waste does not pose a threat of serious environmental damage, may be relatively easy to overcome through the dissemination of food waste information.
Parizeau et al (2015)	Canada	Household-level dynamics of food waste	222 households	Descriptive	Food awareness, waste awareness, family lifestyles, and comfort lifestyles can

Literature	Location	Title	Sample	Method	Result
		production and related beliefs, attitudes, and behaviours in Guelph, Ontario			influence household food-wasting behavior in different ways. Concluded that it is important to understand the diversity of factors that can influence food wasting behavior at the household level in order to design waste management systems and policies to reduce food waste.
Mallison et al (2016)	United Kingdom	Attitudes and behaviour towards convenience food and food waste in the United Kingdom	928 Consumers	Qualitative (Questionnaire)	Fresh vegetables were the most wasted (8.6%) followed by fruit (8.1%), describing the wasting behavior of each consumer group of leftovers, cooked but not served food, stored food from previous meals, and both partially and partially used unopened discarded product
Raquel et al (2017)	Barcelona	Moving ahead from food-related behaviours: an alternative approach to understand household food waste generation	418 Consumers	Cross Sectional (Questionnaire)	Food waste is directly influenced by purchasing discipline, waste prevention habits and materialism values are indirectly influenced by environmental values.
Abdelradi (2017)	Mesir	Food waste behaviour at the household level: A conceptual framework	1200 people	Cross Sectional (Questionnaire)	All of the variables studied have been shown to significantly affect food waste, besides that individual perceptions in the household affect food waste
Rusell et al (2017)	United Kingdom	Bringing habits and emotions into food waste behaviour	172 Consumers	Cross Sectional	Respondents experienced more negative emotions when they thought about leftovers meant to reduce their waste, but ended up wasting more food. Results also showed that participants with a greater sense of control, and more normative support for reducing food waste also had stronger intentions to engage in the behavior.
Delley and Brunner (2018)	Switzerland	Household food waste quantification: comparison of two methods	506 household manager	Cross Sectional : self-reporting and national waste composition analysis report	Based on self-reporting, it was reported that 8.9 kg of food waste could be avoided by households per capita/year. Meanwhile, based on the analysis report on the composition of waste, 89.4 kg of household food waste per capita per year can be avoided.
Afifah (2018)	Malang	Factors Affecting Household Behavior towards Food Waste.	48 Household Respondents	Structural Equation Modelling-Parsial Least Square (SEM-PLS)	The dominant factors that influence food waste are food choices, food handling, and shopping routines.

Literature	Location	Title	Sample	Method	Result
Talia et al (2018)	Capania	Consumer behaviour types in household food waste	213 people	Qualitative (Questionnaire)	They do their food shopping once a week and don't use the grocery list at the time of purchase which can lead to unnecessary purchases
Kim *et al* (2019)	Australia	Consumer perspectives on household food waste reduction campaigns	414 Consumers living in Australia	Cross Sectional (Questionnaire)	Demonstrate the value of applying social marketing and co-design processes to household food waste issues. In addition, consumers are more focused on reducing fruit and vegetable waste.
Nugraha (2020)	Indonesia	Factors Affecting Community Participation in Reducing Household Waste in Bogor City	196 people	Cross Sectional (interview)	Educational and age factors are very influential and significant on community participation to carry out community-based waste management (Basiba) or reduce their own waste generation.
Fami et al (2021)	Tehran	The relationship between household food waste and food security in Tehran city: The role of urban women in household FCM management	1197 Domestic women involved in FCM	Case Study (HFIAS 30 days)	As many as 64.2% of households are food safe, most of the food waste is related to edible leftovers such as bread, cooked rice, cooked pasta, which implies that its reduction can contribute to improving food security

RESULTS AND DISCUSSION

According to the World Food Program (2020), 55 countries and territories are in food crises, 183 million people are under stress, and living at the peak of acute hunger, and 17 million children suffer from acute malnutrition. This data increases in 2021 to 19.4 million people on a global scale. The United Nations Environment Program (2021) estimates that 931 million tonnes of food is wasted by households, restaurants and retail stores, accounting for 17% of the total food waste originating from consumers.

Food waste is even more serious in developed or rapidly developing economies, and these countries must take greater responsibility to prevent food wastage and contribute more to the world (FAO 2019). For example, food waste in the United States is a very serious condition, where more than a third of all available food is not eaten through loss or waste, and each year, the average American family of four loses $1500 or the equivalent. 21 million rupiah due to uneaten food (USDA 2021). The amount of food waste in Europe reaches 88 million tonnes per year, which is equivalent to 173 kilograms per person (Stenmarck et al. 2016). Meanwhile, food waste has become the largest share of post-harvest losses (PHL) and waste in China, and 17–18 million tonnes of food is wasted only in the catering industry in China each year (Xu et al. 2020). Given the large amount of food waste that comes from households, reducing household food waste is very important for overall food waste mitigation and provides multi-sectoral benefits for humans and survival (Teng et al. 2021).

I. Food Waste in the Household

The main challenge facing the international community is to provide safe food for more than 9.1 billion people by 2050. While the focus is on increasing production by 50–70% to achieve this target, one factor that is usually overlooked is reducing food loss. and waste. Abdelradi (2017) mentions that 32% of the world produces wasted food, where this estimate is based on mass loss and wastage, which does not consider energy in food products. Therefore, Lipinski et al (2013) used calories as an indicator and found that food loss and waste accounted for 24% of all food produced. In addition, Abdelradi (2017) distributes by region the share of world food loss and waste. The results showed that 28% of food loss and waste occurred in industrialized Asia, 23% in South and Southeast Asia, 14% in North America and Oceana, 9% in Sub-Saharan Africa (SSA) and 7% in North Africa, Asia. West and Central. Food loss and waste distribution are grouped according to different stages of the supply chain for different regions. For example in North Africa, West and Central Asia 34% of food loss and waste is at the consumption level and 18% at the distribution

and market level, together representing 52% downstream of the supply chain. In addition, the regional categorization is different based on developed and developing countries and shows that at the level of consumption developed countries produce food waste at 28% compared to developing countries at 7%. Fami et al. (2021) stated that consumer food waste in Europe and North America amounts to around 95-115kg per year per capita, while in Sub-Saharan Africa and South/Southeast Asia it is only 6-11kg/year. Total household waste consisting of fruits and vegetables was 22% in Cameroon, 29% in Saudi Arabia, 20% in Senegal, 38% in Turkey, 39% in Uzbekistan, and 49% in Afghanistan.

The description shows that developed countries waste more food at the consumption stage compared to developing countries (Principato et al. 2019). Chaerul and Zatadini (2020) also stated the same thing that developed countries produce more food waste than developing countries. Meanwhile, Thalia et al (2018) reported that food waste occurs more in urban areas than in rural areas. Examining more deeply in terms of food waste actors in the household, several studies use consumers (individuals) as samples (Abeliotis, Lasaridi, & Chroni 2014; Mallinson et al 2016; Abdelradi 2017; Rusella et al 2017; Raquel et al 2017; Thalia et al. al 2018; Kim et al 2019; Nugraha 2020). Usually women are directly involved in food handling in the household (Parizeau et al 2015; Afifah 2018; Delley and Brunner 2018; Fami et al 2021). Some studies even use a sample of students living in the household to measure the determination of food waste in the household (Rowe, Jessop, & Sparks 2015).

Abeliotis, Lasaridi, and Chroni (2014), used a sample of consumers with middle to upper secondary education (university and professionally active). Based on his research, 13% of the sample placed themselves on the food waste scale, including disposing of significant amounts of food waste (6%) and disposing of "quite little" waste (7%). However, almost half of the sample (49%) admitted to throwing out small amounts of leftover food and 31% throwing away food waste in the very little category. Only 7% admitted to eating without leftovers. When viewed from the point of view of worrying about throwing away leftover food, the majority stated that they cared (90%). Then, when asked about efforts to minimize food waste, 48% admitted to doing many ways to minimize food waste. As many as 42% admitted to doing quite an effort and 11% admitted to doing little effort. The results suggest that individuals 'feel bad' strongly about the concept of wasting food, which provides a good basis for prevention. However, the results also suggest that food waste is most likely the result of consumers' daily routines, even though they consciously want to avoid it. According to Delley and Brunner (2018), the process of disposing of food waste is not always done consciously. Raquel et al (2017) stated that throwing away food waste is not only a response from one behavioral dimension but also arises from various actions and motivations. Based on the research of Rowe, Jessop, and Sparks (2015) buying food, not eating it and then throwing it away is mostly done by families in the UK. Currently the average British family eats around £680 per year or around 13 million rupiah per year. Quantitatively, British households waste 7 million tonnes of food and 60% of that is still edible. Nugraha (2020) states that in addition to awareness and behavior, individual self factors also play a role in the disposal of food waste.

The entire food supply chain produces about 300 kg of avoidable food, of which possible avoidable food waste comes from households (45% in units per capita per year). The average household releases 31.2 kg of waste for collection every week, including an average of 12.5 kg of organic waste sources, 11.6 kg of recycled, and 7.1 kg of residual waste (Parizeau 2015). The distribution of food waste across different food categories is usually observed based on estimates (Kranert et al., 2012) and shows much in common with further studies based on a combination of diaries (Delley and Brunner 2018) and waste composition analysis (Silvennoinen et al., 2014), where fruits and vegetables are the main sources of food waste, followed by bread, prepared foods, and dairy products. The results from WRAP (2013) contrast with previous research, showing beverages to be the main contributor to food waste. The research findings of Rowe, Jessop, & Sparks (2013) and Kim et al (2019) explain that fruit and vegetables are the highest food waste and the reduction in household fruit and vegetable waste is predicted by intentions and perceptions of behavioral control. Poorly controlled habits and emotions are important determinants of intention to reduce food waste and food waste behavior (Rusell et al 2017).

An interesting thing was revealed in the research of Mallison et al (2016), where food waste behavior was also measured on epicures which accounted for 14.5% of the sample and showed different attitudes and behavior characteristics compared to other consumer groups. This group was not interested in snacks and displayed the most negative sentiments towards enjoyment, value for money, and practical aspects. They are most interested in natural foods and show the strongest preference for consumption of fresh and organic produce, while this group is most price conscious and most likely to seek key suppliers. As a group, epicures were the most organized and considered the availability of product information as important. They positively enjoyed trying new foods, rated themselves as the most competent cooks and the least likely to snack, used the microwave less, and cooked most of the time. This

group is the least pressed for time and has the lowest stress levels among all consumer groups. They enjoy family and family involvement, never take food home, and are consistent with their overall negative attitude towards practical food. Epicures were the least wasteful of the five consumer groups, reported wasting only 2.5% of the total food purchased and were most concerned about wasting food.

II. Determinants of Food waste in the Household

The important thing in reducing food waste is not only assessing the level of food waste but also analyzing the important factors that cause the waste. Generally, the higher the household income, the more likely food waste will occur (Yu and Jaenicke 2020). Meanwhile, families generally prepare food based on the number of members in the household. If the number of people eating at home varies, larger families have more food waste (Sosna et al., 2019). Studies in Lebanon show that the food waste problem is even worse in Arab countries, where large amounts of food are wasted every day. A further study in an ethnographic journey documenting food management practices in rural Lebanese households related to food waste found that despite the magnitude of the food waste crisis in Lebanon, significant environmental impacts were not seen in the construction of participants' food-related practices. However, the women exhibited strong aversion to food waste rooted in cultural norms and religious beliefs built on active avoiandce of food waste. This finding describes the complex relationship between family and community routines that have an impact on frugal practices and food management policies (Chammas and Yehya 2020). Many factors affect the disposal of food waste in the household, some of which are listed in Table II.

Table II. Determinant Factors Of Food Waste

Literature	Determinant Factors								
	D1	D2	D3	D4	D5	D6	D7	D8	D9
Abeliotis, Lasaridi, and Chroni (2014)				v		v			
Rowe, Jessop, and Sparks (2015)				v			v		
Parizeau et al (2015)			v	v	v	v	v		
Mallison et al (2016)				v					v
Raquel et al (2017)							v		
Abdelradi (2017)	v		v	v			v	v	
Rusell et al (2017)					v				
Delley and Brunner (2018)				v	v		v		
Afifah (2018)				v		v	v		
Talia et al (2018)	v				v				
Kim *et al* (2019)							v		
Nugraha (2020)	v								
Fami et al (2021)	v	v	v		v	v	v	v	

*Information:
D1: Individual characteristics
D2: Family characteristics
D3: Food expenditure
D4: Food selection
D5: Habit
D6: Practice shopping
D7: Practice waste minimization
D8: Materialistic values
D9: Product attributes

Table II shows that there are 10 determinants of food waste, namely individual characteristics, family characteristics, food expenditure, behavior, food selection, habits, shopping practices, waste minimization practices, materialistic values, and product attributes. As many as 92% of studies state that behavior is the main factor in the occurrence of food waste. The behavior referred to here is an action based on certain motivations such as food selection, food consumption habits or routines, food waste reduction practices, both storage and recycling of food products, and shopping practices including shopping frequency and time. The spectrum of food-related behavior by consumers is associated with household leftovers (Schanes et al., 2018). Some behaviors lead to relatively higher amounts of waste (such as shopping at large supermarkets), while others lead to lower amounts (such as use of meal plans and shopping lists).

Another determinant factor that affects food waste is individual characteristics including age, education, knowledge, and religion. Then, family characteristics include marital status, household assets, and family size. In addition, factors that affect food waste are food expenditure, materialistic values (attitudes, beliefs, comfort), and product attributes (price, labels, and packaging).

Boulet et al. (2021) explains the multi-level perspective in determining food waste in households, namely micro, meso, and macro:

• Micro (individual)

The focus entity here is the individual, where categorization is common across various disciplines, individuals are the building blocks of social systems and they have different internal factors, such as attitudes, knowledge, skills, life experience and financial resources, which influence their behavior.

• Meso (household)

The social unit (ie group) within the physical setting of the household is the focus at this level. The social unit is often the biological unit of the family, but can be a collection of other people living together in the same household. A household is not only a collection of individuals and their characteristics, but is also determined by their interactions. Influencing factors include group-level characteristics, such as composition, cohesion, structure and interdependence, as well as the physical attributes of the house itself.

• Macro (outside the household)

The focal entity here is the physical and social setting outside the household. This level is potentially endless and proximal to the influence of external physical settings (such as workplace, school, supermarket) and social networks (such as: friends, family, neighbors) with whom individuals in households interact frequently. Beyond this, more distal and sometimes indirect influences, such as social values, regulatory frameworks, income average, commercial market, and climatic conditions.

Behavior in the household has broad dimensions, but based on a review of the study, the determinants are related to how the family has their food, eating and buying habits, shopping practices for daily fulfillment, as well as. the practice of minimizing food waste through proper food storage and recycling, Based on food selection, a study linked how food selection affects food waste among students at various universities such as Stanford University, the University of California, Berkeley, the University of California, Davis, the University of California, Santa Barbara, and Lebanon Valley College. The results of the study show that students' beliefs and preferences for a food attribute encourage the taking of large quantities of food and then producing leftovers. Choosing wiser and healthier foods leads to producing less leftovers (Wiriyaphanich et al 2021). While it is related to eating or buying habits, a study reports that healthy eating habits and wise food shopping, pre-purchase preparation, and proper use of food significantly affect food waste.

Based on the practice of waste minimization, 8 of the 13 studies reviewed stated that several ways to minimize food waste have been carried out by households. Such practices include storing food properly according to the type of food ingredient, then reusing or recycling household products. To support this practice, food processing skills are needed. Food skills, defined as the complex, interrelated, people-centred skills needed to provide and prepare safe, nutritious and culturally acceptable meals. Confidence in food concept was significantly positively related to avoidable daily food waste per capita ($b = 34.1$; 95% CI, 7,660.6). Confidence in food processing techniques was also significantly positively related to avoidable daily food waste per capita ($b = 39.2$; 95% CI, 8.3−70.1) (Carroll 2020).

III. Food Waste Preventive Strategies in the Household

Based on the previous description, there is increasing evidence that households contribute greatly to the problem of food waste. Therefore, it makes sense to prevent food waste at this level. A number of behaviors have been shown to

affect the generation of food waste (Evans, 2012; Koivupuro et al., 2012; Stefan et al., 2013) so it needs to be studied to develop efficient preventive measures. Food consumption and wasteful behavior may have large cultural variations across countries, which requires a closer look at the geographic context. To date, information on the attitudes and behavior of households in Greece regarding food waste is minimal. Based on a study in China, Min et al. (2021) found that increasing the dietary knowledge of household decision makers can reduce food waste. Some food policies can also reduce household food waste. For example, Italy's food donation policy could reduce the number of people throwing away food after the best before (Busetti 2019) date. The study conducted by Wiriyaphanich et al (2021) suggested (1) changes in the way of obtaining food, consumers reduce the number of shopping trips and buy more on each trip to minimize store visits; (2) reduce spikes in hoarding of non-perishable foodstuffs or avoid panic buying; (3) a shift towards healthier eating patterns; (4) increasing culinary skills; (5) reduction of food waste. Several preventive strategies from the literature review to reduce food waste in households are presented in Table III.

Table III. Preventive Strategies to Reduce Food Waste

Literature	Preventive Strategies							
	S1	S2	S3	S4	S5	S6	S7	S8
Abeliotis, Lasaridi, and Chroni (2014)	v	v	v	v				
Rowe, Jessop, and Sparks (2015)	v		v		v			
Parizeau et al (2015)							v	v
Mallison et al (2016)	v				v			v
Raquel et al (2017)					v			v
Abdelradi (2017)					v			
Rusell et al (2017)					v			
Delley and Brunner (2018)							v	
Afifah (2018)	v				v			
Talia et al (2018)					v			
Kim *et al* (2019)					v		v	
Nugraha (2020)						v		
Fami et al (2021)		v			v	v		

*Information:

S1: Shopping planning

S2: Changes in diet

S3: Limitation of food expenditure

S4: Lifestyle changes

S5: Education and socialization about food waste

S6: Construction of waste/donation

S7: Recycle

S8: Regulatory strengthening

Based on Table III it can be seen that various preventive strategies were recommended in various study reviews. The most recommended strategy is to increase the knowledge of food management in the household about food waste through education and

outreach activities. A socialization and education activity and the practice of managing waste into food carried out in Bandung are effective in overcoming the waste problem, but the low level of community participation makes this program not show maximum results. However, the development of waste management activities has proven to be able to reduce organic waste disposal. Therefore, it is necessary to develop a strategy to encourage better waste management in the community (Al-Amin 2021). In addition, activities that can be carried out involve community participation, namely the construction of a waste bank or food bank to donate inedible food to people in need. By utilizing technology, various efforts to reduce food waste have been carried out in several countries. In the United States and Canada, there is a FlashFood application that resells wholesale food that is approaching its expiration date and in Indonesia there is a Garda Pangan startup that participates in reducing food waste, especially in the city of Surabaya. Rosa et al (2021) stated that the development of startups in the form of applications is very helpful in solving problems in various sectors. The design of this application can help solve food waste problems by donating through food ingredients and foods that are still edible.

Another preventive strategy is recycling activities, this activity is a solution for increasing consumption. However, for some scientists, recycling is not very attractive because recycling requires energy during the process (Astuti et al 2019). Even so, recycling can be an alternative to prevent environmental damage due to over consumption. Several studies have proven that recycling behavior can increase environmental awareness which will have an impact on reducing food waste production (Abdelradi 2017). Recycled food waste can be in the form of compost. Dewilda, Aziz, and Fauzi (2019) explained that organic waste has a recycling potential of 91.71% for composting. This potential is quite high because it almost reaches 100%. This waste consists of food waste from restoram vegetables, fruit peels and others that can be used as the basic material for composting. It was further stated that the compost produced from food waste has good compost characteristics, with a C/N ratio that is sufficient to replace peat soil for horticultural crops.

Not only activities that involve community participation, but preventive strategies can be started from the individual himself. Such as shopping planning, dietary changes, lifestyle changes, or food expenditure restrictions. Romani et al (2018) in their research stated that individual daily practices related to food (for example, shopping, cooking, eating, etc.) lead to a reduction in food waste. Survey data collected among a sample of 1062 in Denmark measures consumers' intention not to waste food, plan for shopping and reuse leftovers, household food handling skills, legal and moral norms, attitudes towards food waste, and behavioral control. that is felt. The results show that perceived behavioral control and routine related to shopping and reuse of food waste are the main factors of food waste, so there needs to be management between these factors (Stancu, Haugaard, & Lahteenmaki 2016).

The government also plays a role in reducing food waste through planning and strengthening regulations or policies. Policies to encourage food savings in homes and public places should be promoted to address the food waste challenge (Dagiliute 2019). Dou et al (2016) suggest that among other measures to avoid food waste also demonstrate the importance of consumer education, as well as stakeholder mobilization and fostering innovation for a sustainable food system.

CONCLUSION

Food waste is still a neglected factor in achieving food supply targets because the policy focus is still directed at increasing production. Food loss and waste accounts for > 20% of all food produced, which should be avoided because reducing food waste can increase food availability for the community. The most widely discussed determinants in the study review are behaviors that include food selection, eating habits and food processing, shopping practices, and waste minimization practices. The potential for reducing food waste can be increased with the most dominant preventive strategies, namely education and socialization, then food management at the individual level, community and government participation.

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